(3) a temperature within certain fixed limits—it follows that the reaction in question must occur; for, if it did not, the atoms would be in a state of strain inconsistent with stability; it would be as if a stone did not fall to the earth when there was nothing to prevent its falling. As a consequence of this, it follows that, in any complex system of atoms, where two or more different arrangements are independently possible, and where the various products remain within the sphere of action, and are capable of further interaction, then, those products, the formation of which is attended with the greater evolution of heat, will be formed to the exclusion of the others; or, if the two actions develop the same amount of heat, they will both occur to an equal extent.

I showed that the division of a base between two acids takes place entirely in accordance with this principle; wherever the salt formed remains undissociated in the liquid, the base is divided equally between the two acids, because the heat of neutralization of all such acids is the same, whereas, in other cases, where one of the salts formed is stable, and the other is in a state of partial dissociation, the undissociated salt is formed to the exclusion of the dissociated one; such small divergencies from this rule as are observed being due to the solutions examined being considerably stronger than they should have been, the heat of neutralization in such cases not exhibiting absolute constancy, and the dissociation of the dissociated salts being incomplete. This simple principle does away with the cumbrous hypothesis that each acid and base possesses a certain "avidity" or "affinity" peculiar to itself—an hypothesis which is, as I then pointed out, at variance with many facts of the case. A very striking confirmation of my views has been afforded by finding that the heat of neutralization of sulphuric acid in very weak solution is normal, thus verifying a prediction which I made on the strength of the above considerations.

I formerly held that the dissociation which explains endothermic reactions cannot be that of the product, but only that of the reagents; this I still think is true in cases where the product would dissociate into the same substances as the reagent would (if this latter could dissociate)—*e.g.* the hydrate of a salt dissociating into water and the elements composing the salt—but it is not true in other cases; for instance, a hydrate formed by dissolving a salt may dissociate into acid and base, and cause thereby an absorption of heat.

As with two possible reactions, where the products remain within the sphere of action, that which develops the most heat will occur to the exclusion of the other, so in two possible decompositions where the products remain within the sphere of action, that which absorbs least heat will occur to the exclusion of the other; and the question consequently arises, Why does a hydrated salt dissociate into acid and base, instead of into the anhydrous salt and water? The probable explanation is that in many cases the latter dissociation would be the more endothermic of the two; for the salt molecules in various contiguous hydrates are so far removed from the sphere of each other's attraction, that their attraction for each other would be practically *nil*, and the hydrate could only dissociate to form water and *free* salt molecules, absorbing in so doing a quantity of heat exceeding the observed heat of dissolution by an amount corresponding to the heat of fusion and volatilization of the salt, and exceeding in many cases the heat of neutralization itself. The presence of excess of water would moreover practically prevent the dissociation of the hydrate into water and the anhydrous salt.

A class of endothermic changes which present considerable difficulties are those which occur without the absorption of external energy in living organisms. We are at present so utterly ignorant of the nature of the reagents and products that it is hopeless to attempt any explanation of the *modus operandi* in these cases, but a suggestion made by Mr. Warrington at the recent meeting of the British Association with regard to the nitrifying organisms indicates the direction in which such an explanation may be obtained on the same principles as those given in the cases here discussed. SPENCER U. PICKERING.

THE WORKING OF THE TECHNICAL INSTRUCTION ACT AND THE LOCAL TAXATION ACT.[1]

THE Secretaries of the National Association for the Promotion of Technical and Secondary Education, in reporting on the working of the Technical Instruction Act, have to congratulate the Association on the rapid progress which has been made during the last year in taking advantage of the benefits of the Act. This is partly to be ascribed to the grant of a small sum by the Science and Art Department to meet local effort, but chiefly to the allocation to County Councils of England and Wales, under the Local Taxation Act of this year, of a sum amounting in all to £743,000, with permission to use it for the benefit of education over and above any sum that may be raised by rate under the Technical Instruction Act.

Technical Instruction Act, 1889.—The number of local authorities in England and Wales which have taken advantage of the Technical Instruction Act has risen from *four* to *forty* since the date of the Manchester Conference a year ago. These districts are as follows:—Atherton, Aberystwith, Barnsley, Birmingham, Birkenhead, Blackburn, Burnley, Burslem, Bridgwater, Bingley, Bolton, Blaenau Festiniog, Cardiff, Coventry, Darwen, Guiseley, Keighley, Kidderminster, Manchester, Maidstone, New Mills, Macclesfield, Northampton, Nottingham, Oxford, Rochdale, Rotherham, Sheffield, Stockport, Salford, Shipley, Sherborne, Southport, Stalybridge, Worcester, Wakefield, Wrexham, Westmoreland, Widnes, and York. This list is probably not complete. In addition to the above, several of the Welsh County Councils have appointed their Intermediate Education Joint Committees to be Committees under the Technical Instruction Act.

Local Taxation Act, 1890.—In addition to these districts, a number of counties have taken action in the direction of utilizing the local taxation grant under the machinery of the Technical Instruction Act.

The following English counties have already resolved to set aside the whole or part of the money for education:—

Shropshire has set aside the whole of its share, amounting to £6543, for education, and the Technical Instruction Committee has presented a valuable report on the use of the money.

Somersetshire has set aside the whole of its share, about £11,000, for education, and is now engaged in considering applications.

The Technical Instruction Committee of Hertfordshire has recommended that the whole of the sum (£6429) be devoted to education.

Staffordshire has voted £7000 for education, and a scheme for its distribution is being framed.

Oxfordshire has set aside half of the grant, about £2000, for education, and Gloucestershire has also voted half the grant for the same purpose.

The North Riding of Yorkshire has voted £2000 for education.

Cheshire and Devonshire have determined to devote some part of the fund to education.

Leicestershire gives £300 to the Leicestershire Dairy Association, and Westmoreland gives £250 to existing schools, to be spent on apparatus.

The county borough of Croydon has voted the new fund to meet capital expenditure on technical instruction.

Besides these twelve districts (eleven counties and one county borough) which have definitely voted the whole or part of the new fund for education, the subject is now receiving careful consideration in a large number of districts, in many of which the new fund is practically certain to be applied, at least in part, to educational purposes.

Conspicuous among these districts is the county of Lancashire, which was the first to move in the matter, having appointed a Technical Instruction Committee in August last, which is just now reporting results of exhaustive inquiries as to the best means of assisting education from the new fund. Essex also has advertised for applications for a share of the money, and is now considering such applications with a view to assisting technical education. Committees have been appointed to consider the question in the following twenty counties:—Kent, Wiltshire, Cornwall, Berkshire, Northumberland, Peterborough, Southampton, Cumberland, Durham, East and West Sussex, Cambridgeshire, Worcestershire, Warwickshire, Dorset, West Riding, East Riding, Bedfordshire, and Herefordshire, and London. In London, however, the bulk of the grant for the present year has been used for the reduction of rates.

A large number of county boroughs are considering the desirability of using the new money for education. It is stated to be most probable that it will be so used in Nottingham, Salford, Blackburn, and Bradford. Worcester proposes to increase its grant under the Technical Instruction Act by £450, to be taken out of the new fund.

In addition to the above, the following county boroughs

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[1] Secretaries' Report, read at the Conference on December 5.

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among others, have the matter now under the consideration of a committee:—Barrow, Bootle, Burnley, Canterbury, Gateshead, Hull, Leeds, Norwich, Oxford, Southampton, and Wigan.

In Wales the County Councils, with at most one or two exceptions, are proposing to utilize all the new fund for the purposes of education. In most cases the money will be used under the Intermediate Education Act, but some Councils, as, for example, Cardiff, have resolved to divide the fund between intermediate and technical education.

The general results hitherto attained, so far as the information of the Association goes, which is probably incomplete, may be summarized as follows:—

English.

County Councils which have voted money to education under the new Act	11
County Councils which have appointed committees to consider the question	22
Total counties moving in the matter ...	33 out of 49

This result has been attained during the short period of four months since the passing of the new Act, during the first half of which time hardly any County Councils were sitting. The figures for county boroughs are as follows:—

English county boroughs working the Technical Instruction Act	17
County boroughs allotting the new fund for education, but not rating themselves ...	1
Other county boroughs considering the application of the new fund for education ...	9
Total county boroughs moving in the matter	27 out of 59
Other districts in England working the Technical Instruction Act	19

The general result gives a total of 47 local authorities as yet assisting technical education in England.

This is exclusive of the Welsh counties and county boroughs, which, broadly speaking, may be said to be devoting almost the whole of the new fund to the purposes of education.

The total number is likely to be very largely increased when it becomes generally known that there is every reason to believe that the grant, or at least so much as is applied to education, will be renewed in the future.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, December 8.—M. Duchartre in the chair.—Observations of minor planets made with the great meridian instrument of Paris Observatory, from Oct. 1, 1889, to March 31, 1890, communicated by Admiral Mouchez.—Experiments on the mechanical actions exercised on rocks by gases at high pressures and in very rapid movement, by M. Daubrée. The author applies the results recently arrived at (*Comptes rendus*, December 1) to the creation of volcanic ducts, and shows that it is probable that they are produced by mechanical actions much superior to the volcanic actions of which eruptions are the effects.—On the membrane of the lymphatic sac of the œsophagus of the frog, by M. Ranvier.—Proof that π cannot be the root of an algebraic equation having entire coefficients, by Prof. Sylvester. It is remarked that this proof should be substituted for the note by the same author, which unfortunately appeared in *Comptes rendus* of November 24. The latter note, which only dealt with a restricted case of the theorem enunciated in the text, is affected by inaccuracies which render it of no value.—A new method of studying the compressibility and the expansion of liquids and gases; results obtained with oxygen, hydrogen, nitrogen, and air, by M. E. H. Amagat. The experiments have been made between 0° and 200° C., and with pressures from 100 to 1000 atmospheres. The results obtained indicate that the coefficient of expansion of hydrogen at constant pressure diminishes regularly with increase of pressure. In the cases of oxygen, nitrogen, and air, the coefficient is at a maximum at the commencement, and this maximum corresponds to the pressure at which the product pv has the least value. The results obtained when the gases were reduced to constant volume show that $\frac{dp}{dt}$ is always greater between 0° and 100° than between 100° and 200°. The coefficients between 0° and 100°, at a pressure of 500 atmospheres, are 3·698, 3·085, 2·971, and 1·895, for oxygen, air, nitrogen, and hydrogen respectively. The values obtained at other pressures and temperatures follow a similar sequence.—Observations of Zona's comet, made with the great equatorial of Bordeaux Observatory, by MM. L. Picart and Courty. Observations for position were made on November 29 and 30.—On the observations of the transits of satellites of Jupiter and on the occultations of stars, by M. Ch. André.—On a transformation of motion, by M. Dautheville.—On the fluoride of allyl, by M. H. Meslans. Some of the physical and chemical properties of this compound are given. This ester is a colourless gas, possessing an alliaceous odour; it is formed from the iodide according to the equation $C_3H_5I + AgF = C_3H_5F + AgI$.—On some endothermic and exothermic reactions of organic alkalies, by M. Albert Colson.—On some derivatives of dimethylaniline, by M. Charles Lauth. A method of preparing tetramethylbenzidine is given, by which a yield of 40 per cent. may be obtained. Tetramethylbenzidine in hydrochloric acid solution is acted on at 45° by ferric chloride; fine green crystals of an unstable dye are produced, of which the formula is shown by analysis to be $C_{16}H_{21}ClN_2O$.—Contributions to the study of the nucleus of Spongidæ, by M. Joannes Chatin.—On the new class of jumping Acarina (*Nanorchestes amphibius*) from the coast of the British Channel, by M. Topsent and Dr. Trouessart.—On the age of sands and clays of the south-east, by MM. Ch. Depéret and V. Leenhardt.—Observations on extracts of meat, by M. Balland.

CONTENTS.

PAGE
Shaking the Foundations of Science 145
The Palæozoic Fishes of North America. By A. S. W. 146
Hand-book for Mechanical Engineers. By N. J. L. 147
Fossil Flora of Australia. By J. S. Gardner 148
Our Book Shelf:—
  White: "The Development of Africa" 149
  Williams: "The Pinks of Central Europe" 149
  King: "Materials for a Flora of the Malayan Peninsula" 149
  Barton: "The Colonist's Medical Hand-book" . . 150
Letters to the Editor:—
  Dr. Romanes on Physiological Selection.—**Dr. Alfred R. Wallace** 150
  A Large and Brilliant Fire-ball Meteor.—**Rev. A. Freeman: Robert Hunter** 150
  Attractive Characters in Fungi.—**J. S.** 151
  Some Habits of the Spider.—**W. H. Hudson** . . . 151
  "Nowhere can Mathematics be learned as at Cambridge."—**Prof. George M. Minchin** 151
The Darkness of London Air. (*Illustrated.*) **By W. Hargreaves Raffles** 152
Vibration-Recorders. By Prof. John Milne, F.R.S., and John Macdonald 154
Glacial Climate. By Prof. N. S. Shaler 155
The Subject-matter of Exact Thought. By A. B. Kempe, F.R.S. 156
Notes 162
Our Astronomical Column:—
  Variations of Certain Stellar Spectra 165
  British Astronomical Association 165
  Elements and Ephemeris of Zona's Comet (*e* 1890) . 165
Chemical Action and the Conservation of Energy. By Prof. Spencer U. Pickering, F.R.S. 165
The Working of the Technical Instruction Act and the Local Taxation Act 167
Societies and Academies 168

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